STUDY OF ELECTRICAL METHOD OF ATOMIZING FOOD PRODUCTS

V.YA.SVINTSOV

Technological Institute of Meat and Milk Industry, 490011 Semipalatinsk, Glinka Street 49, the Republic of Kazakhstan.

SUMMARY: The object of the investigation is new electrical method of atomizing liquid-like food products and atomizing electrical blocks of atomizing drying units. Experimental studies were carried out to determine functional dependence of physical and dispersing characteristics of atomized products upon physical characteristics of initial products and upon feeding voltage value of electrical atomizer.

INTRODUCTION: Convectional drying of atomized products is widely applied in food industry when drying blood and blood-substitutes, medical preparations, milk and milk products, eggs, vitamins, coffee, etc. Initial product atomizing is one of the main processes in powder - like products' production. The most important characteristics of atomizing process are : expenditure of energy, dispersity and size equality of the particles. Qualitative characteristics of finished products depend on above mentioned characteristics. The analysis of atomizing methods showed that two methods are used in meat and milk industry: disk method and atomizing method. These methods do not let to provide completely optimum parameters of drying processes and quality of finished products because of high polydispersity of particles, that is appeared during atomizing of raw material. The particles of atomized drying products are not equally effected by drying agent during thermal processing. This leads to irreversible physical changes of finished product. The defects of the methods are: some losses of product in drying chamber, much expenditure of energy during atomizing, that is 10-15 kw for atomizing of 1000 kg initial product. So we are looking for the new method with good prospects which will have better characteristics in comparison with atomizing and disk methods. Having analized all the methods which are used in different branches of science and technology we have found that atomizing using high-voltage field is the most available method. Preliminary technical calculations of method have showed that there is less expenditure of energy, higher quality of grinding process.

MATERIALS AND METHODS: Basis of the method is artificial electrical atomizing of product. Electric atomizing is carried out by passing the product through strong electric field or by passing electric charge through metallic rod before the product flew from the rod. Atomizing power of electric field depends upon constructive characteristics of atomizer, electric properties of products and value of electric field's voltage. To determine the value of voltage we have used modified method of stalagmometer. Experimental unit for voltage determination consists of 2 parts: electric high-voltage block used for transmission of supply voltage from 0 to 40 kv to modified stalagmometer; the second part of stalagmometer consists also of earthed burettes, analytical scales and earthed metallic stand.

To modernize the stalagmometer we connected the lower part of its base and metallic hollow capillary channel to calibrated outlet. The calibrated outlet was connected to high-voltage block of feeding. To determine surface voltage we transmitted supply voltage from 0 to 10 kv from high-voltage block to modernized stalagmometer. High-voltage block was used for transmission of supply voltage from 0 to 40kv to modified stalagmometer. Methods of determining surface voltage is as follows. Supply voltage from 0 to 10 kv was supplied from high-voltage block to modernized stalagmometer. The product tested under the action of gravity forces flowed from stalagmometer to the media forming drops on the outlet of the metallic capillary and at the same time charging it on the account of contacts with capillare channel's surface. After a hundred of drops had been collected weight of a drop was calculated:

$$P_1 = \frac{P_{100} - P_0}{100} \quad ; \quad (1)$$

where P_{100} - weight of burettes with 100 drops of the product tested;

P_0 - weight of hollow burettes.

Using the correlation of a drop weight and surface strain the numerical sign of the latter was calculated:

$$\sigma_x = \frac{P}{2P} \quad (2);$$

where: r - calculating radius of capillare outlet.

To determine dispersive characteristics of atomized in electric field food products we have made and used the model of electric atomizer. It consists of high-voltage block, rod and deep-well pump. Deep-well pump ensured transmission of atomized product to the rod of electric atomizer. Control of dispersive influence of electric field upon product and measuring diameters of atomized particles was carried out by using photographic method and by measuring of particles' tracks.

RESULTS AND DISCUSSION: This material includes vast results of experimental investigations but is limited by amount of the report. So we have to dwell upon the results of experimental investigations of model liquids. We have used water and common salt solutions of different concentration as model liquids.

table 1

Dependence of surface strain of model media upon feeding voltage of electrode system

№	voltage kv	Surface strain $\sigma \cdot 10^3$ n/m									
		Water	Common salt solution 1%	2%	3%	4%	5%	6%	7%	8%	9%	10 %
1	0,0	73,0	74,2	75,8	76,5	77,2	78,0	78,2	78,7	79,1	79,4
2	1,0	70,0	72,0	72,9	73,8	74,1	74,7	75,5	75,8	76,0	76,1
3	2,0	66,0	68,4	69,8	70,1	70,8	71,6	71,9	72,0	72,2	72,9
4	3,0	62,0	62,8	63,6	64,0	64,8	65,2	65,8	66,0	66,2	66,6
5	4,0	50,0	50,8	51,4	52,1	52,4	52,6	52,9	53,1	53,5	53,7

Experimental investigations of surface strain, the results of which are in table 1, are limited by the range of feeding voltage of electrode system from 0 to 4 kv.

Table 2 shows some results of experimental investigations of atomizing on electric atomizing unit model.

Dependence of particles' diameter upon feeding voltage — Table 2

name	Diameter of the rod's outlet (mm)	Feeding voltage of electrode system (kv)								
		1,0	2,0	3,0	4,0	5,0	8,0	10,0	12,0	15,0
atomizing drops diameters (mm)	0,25	0,22	0,215	-	0,15	0,111	-	0,108	-	0,085
	0,7	-	-	-	-	0,285	0,113	0,133	0,106	0,100
	2,0	-	-	-	-	0,244	—	—	0,156	0,187

Some data about dependence of quality indices of atomizing process upon expence of atomizing substance, configuration and geometric characteristics of electrode system are not mentioned But, inspite of this, we'll try to show fullt the results of analization of atomizing liquid in the electric field:

1. Mean diameter of the drops becomes non-linear smaller with the increase of voltage of the high-voltage electrode and tense to decreasing lower limit, which is 6–13 times less of the atomizing unit rod diameter.

2. Difference of drops' diameters is small: minimum and maximum diameters vary from 1,5÷2,0 Thus the less is a diameter and the higher is the feeding voltage of electrode system, the less is the difference of diameters.

3. Mean diameter of the particles of atomizing liquid is practically unchangeable under the feeding voltage leads to the increase of atomizing angular.

4. With the diameter of the rod outlet of atomizing unit over $1,0 - 10^{-3}$m, atomizing angular has clear centre and outlying area. A mean diameter of drops in the centre is much larger than that of the outlying area.

5. Electric power consumed by the atomizing unit is much less (not more than 3 kwt) than that consumed by mechanic sprayer.

6. The quality of atomizing process is automatically regulated by feeding voltage and besides by using rods of different outlet diameters.

CONCLUSIONS: the results of experimental investigation of atomizing by electric field, proved good prospects of electrophysical method of food products processing. This is caused by great save and improvement in quality of atomizing by electric field. Improvement of the grynding quality depends upon decrease of losses of cyclon fractions products and improvement of the main technological drying process as well.